CLAIMS

WHAT IS CLAIMED IS:

1. A joint restraint assembly for connecting pipe ends together, or to other objects, by gripping the outer surface of the pipe, the joint restraint assembly comprising:

a body encircling the pipe, with said body having a plurality of cavities adjacent the pipe and at least one set of a corresponding plurality of threaded bores disposed through said body, each threaded bore of said at least one set of a corresponding plurality of threaded bores being in communication with a respective cavity;

a segment disposed within each of said cavities in said body, and configured to make contact between said body and the surface of the pipe so as to provide resistance to pipe pull-out in proportion to the mechanical and/or internal pressure loading applied to the pipe; and

a threaded bolt extending through each of said threaded bores to pre-load said respective segment into initial contact with the pipe surface.

2. The joint restraint assembly of Claim 1 wherein the ability of the assembly to resist pipe pull-out at increasing levels of mechanical loading and/or internal pipe pressure is independent of said threaded bolts.

3. The joint restraint assembly of Claim 1 wherein said segment is configured to transmit the load from the pipe to said body while loading said segment primarily in compression.

4. The joint restraint assembly of Claim 3 wherein said segment further comprises at least one edge capable of penetrating the external surface of the pipe.

5. The joint restraint assembly of Claim 4 wherein said at least one edge forms a relief angle, as measured from the pipe surface, that is 25 to 35 degrees, so as to optimize both the structural integrity of the segment edge and the ability of the edge to penetrate the pipe surface.

6. The joint restraint assembly of Claim 3 wherein the circumferential length of all of said segments and their edges comprises a substantial portion of the pipe periphery, thereby distributing the force transmitted through contact with the pipe more uniformly around the pipe periphery, and distributing the force transmitted through contact with the body more uniformly around the body, independently of said threaded bolts.

7. The joint restraint assembly of Claim 1 wherein the shape of the body is optimized to resist the forces imparted to it by contact with said segments, said body comprising:

a substantially cylindrical portion adjacent to the pipe surface with a flange extending radially therefrom; and

wherein said body comprises a shape and wall thickness to compensate for the presence of said cavities to maintain the strength and rigidity of said body.

8. The joint restraint assembly of Claim 1 further comprising an elastomeric material positioned between each of said segments and their corresponding cavities, said elastomeric material disposing said segment in said cavity in an optimum position for self-actuation or for retaining said segment in said cavity for shipping, handling and installation.

9. The joint restraint assembly of Claim 1 wherein said segment comprises a cam surface that engages and rotates against the pipe surface to resist pipe pull-out at comparatively high levels of mechanical loading and/or internal pipe pressure in proportion to the loading.

10. The joint restraint assembly of Claim 9 wherein the ability of the assembly to resist pipe pull-out at increasing levels of mechanical loading and/or internal pipe pressure is independent of said threaded bolts.

11. The joint restraint assembly of Claim 9 wherein said segment is configured to transmit the load from the pipe to said body while loading said segment primarily in compression.

12. The joint restraint assembly of Claim 1 wherein said cam surface further comprises a surface texture for engaging the pipe surface.

13. The joint restraint assembly of Claim 12 wherein the ability of the assembly to resist pipe pull-out at increasing levels of mechanical loading and/or internal pipe pressure is independent of said threaded bolts.

14. The joint restraint assembly of Claim 12 wherein said segment is configured to transmit the load from the pipe to said body while loading said segment primarily in compression.

15. A method for providing a joint restraint assembly with resistance to pipe pull-out in proportion to the mechanical and/or internal pressure loading applied to a pipe, said method comprising the steps of:

providing a body that encircles the pipe wherein the body has a plurality of cavities and at least one set of a corresponding plurality of threaded bores disposed through said body, said cavities being disposed adjacent the pipe;

disposing a segment within each of said cavities;

pre-loading each segment against the pipe by rotating a corresponding bolt disposed in each threaded bore of said at least one set of a corresponding plurality of threaded bores;

permitting said segment to move within said cavity, independently of said bolts, in response to pipe pull-out forces, said segment being self-actuating and orienting itself so that said segment is in contact with said body and said pipe surface and generates a resistance to the pipe pull-out forces in proportion to the mechanical and/or internal pressure loading applied to a pipe.

16. The method of Claim 15 wherein said step of generating a resistance comprises loading said segment primarily in compression between said body and said pipe surface.

17. The method of Claim 16 wherein said step of permitting said segment to move within said cavity comprises said segment being self-actuating and orienting itself to drive a segment edge, that has been pre-loaded to penetrate the pipe surface, deeper into the pipe surface while another portion of said segment lodges against an inside surface of said cavity.

18. The method Claim 16 wherein said step of permitting said segment to move within said cavity comprises a cam surface rotating against the pipe surface until a first portion of said segment lodges against an inside surface of said cavity.